

# **Oxidation and Hot Corrosion behaviour of Modified NiCoCrAlY Coatings**

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High temperature components such as moving and stationary blades of jet engines and gas turbines, combustors, boiler tubes are often surface coated for improving their oxidation and hot corrosion resistance. An oxide film protecting the substrate is formed by an overlay coating layer of type MCrAlY. The MCrAlY coating can be obtained by various methods like plasma spraying, electron-beam physical vapour deposition, high velocity oxy fuel etc. Despite the flexibility of these processes their infrastructure and the operating costs are high. Electrodeposition is a simple method to develop composite coatings and has been used in the present study to develop Ni/NiCoCrAlY coatings.

Conventional sulphamate electrolyte was adopted to develop Ni/NiCoCrAlY (cobalt contents 10wt%, 40wt% and 60wt%) composite coatings. Al and Cr nano-particles of size 90nm were dispersed in the electrolyte and kept under suspension during electrodeposition. The deposition conditions were optimized to obtain maximum particle incorporation. Yttrium was incorporated by immersing the Ni/NiCoCrAl coating in Yttrium nitrate solution. The obtained Ni/NiCoCrAlY composite coatings were subjected to a homogenization treatment at 1000°C. The Ni/NiCoCrAlY coatings were modified by the addition of reactive element oxides like ceria (CeO<sub>2</sub>), zirconia (ZrO<sub>2</sub>) and lanthanum oxide (La<sub>2</sub>O<sub>3</sub>). The oxidation behaviour of the developed coatings was studied by subjecting the coatings isothermally to a temperature of 1000°C for a duration of 24hrs. The oxidation resistance in terms of weight gain was recorded. It was observed that the weight gain increased with increase in the cobalt content in the coatings regardless of their modification. However, the least weight gain was observed for CeO<sub>2</sub> modified coatings. The coatings were also evaluated for their hot corrosion behaviour in Na<sub>2</sub>SO<sub>4</sub>+NaCl (3:1) medium at 800°C. The hot corrosion behaviour was expressed in terms of weight gain. It

was observed that the weight gain decreased with increase in cobalt content. In other words NiCoCrAlY coatings rich in cobalt displayed better hot corrosion resistance. ZrO<sub>2</sub> modified coatings showed better hot corrosion resistance compared to CeO<sub>2</sub> and La<sub>2</sub>O<sub>3</sub> modified coatings. The coatings were characterized for their surface morphology using FESEM and the nature of oxidation products were identified using XRD and EDX analysis. Thus, considering both the high temperature oxidation and hot corrosion resistance, the optimum coating is ZrO<sub>2</sub> modified Ni<sub>40</sub>CoCrAlY coating.

**Keywords:** Electrodeposition; Modified NiCoCrAlY coating; Oxidation; Hot Corrosion

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